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CJJ 49-1992

Technical Regulation for Protection against Subway Stray Current Corrosion

地铁杂散电流腐蚀防护技术规程

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Chapter I General Provisions

Article 1.0.1 Since the subway stray current (leakage current) has significant corrosive action on urban architecture and subway itself, this Regulation is formulated in order to effectively limit subway stray current, reduce and eliminate its adverse effect and to ensure favorable social and economic benefits for subway.

Article 1.0.2 This Regulation is applicable to the design, construction, operation and maintenance of such subway system as adopts the modes of DC power traction and running rail return-flow; It mainly includes:

I. Measures for the limitation and reduction of stray current value in subway DC traction power supply system;

II. Subway structures and equipments which may receive stray current corrosion or affect its escape;

III. Anti-corrosive measures in subway system.

This Regulation is not applicable to the temporary measures taken during subway construction.

Article 1.0.3 The engineering design of shall includes the contents of protection against stray current corrosion (measures for active protection and passive protection).

Article 1.0.4 During subway construction, it must take all measures for limiting stray current and complete corrosive protection and monitoring facilities for subway structures according to the requirements of engineering design; and those measures and facilities shall receive engineering acceptance. During the construction, the construction quality shall be timely inspected section by section so as to reach the technical index.

Article 1.0.5 As for the perennial subway lines under normal operation, the stray current value shall be reduced in operating modes. The subway lines and their upper structures shall be frequently at clean, dry and well-insulated state.

Article 1.0.6 The protection against subway stray current corrosion shall not only meet the requirements of this Regulation, but also comply with those in the current relevant ones of the nation.

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Chapter II Basic Principles

Article 2.0.1 The basic principles of protection against subway stray current (leakage current) corrosion shall meet the following requirements:

I. The subway stray current shall be reduced to the minimum limit, giving priority to permanent solutions;

II. The stray current shall be prevented from diffusion out of the subway;

III. The underground metallic pipeline structures nearby the subway shall be taken with effective anti-corrosive measures independently.

Article 2.0.2 The newly-built subway lines shall include the following contents of protection against stray current corrosion during their engineering design:

I. Measures for the limitation of stray current in subway traction power supply system and return-flow system;

II. Insulating and waterproof measures for tunnels with reasonable design as well as reliable and durable performance;

III. Protective measures for metallic pipeline structures and steel bars in major structures;

IV. As for cables, water pipes and other pipeline structures along the subway lines, it shall select such materials, structure design and construction methods as meet the requirements of protection against stray current corrosion;

V. Schemes for setting anti-corrosive monitoring points along subway lines and at stations;

VI. Demonstration and implementation schemes of special methods for protection against stray current corrosion.

Article 2.0.3 In the design of "protection against stray current corrosion" for existing subway lines, it shall be based on the results of field measurement and investigation.

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Chapter III Hazard Indicators of Exposing Subway Structures and Equipments to Stray Current Corrosion

Article 3.0.1 Corresponding electric measurement shall be carried out for buildings, structures and equipments of subway in service so as to judge the condition of exposing to stray current corrosion.

Article 3.0.2 The hazard indicators of exposing subway structures and equipments to stray current corrosion shall be determined according to the current density leaking from structure surface to surrounding electrolyte and the polarization displacement of electric potential caused hereof.

Article 3.0.3 As for the direct quantitative indicator leakage current density of electrocorrosion hazards, its allowable values shall be in accordance with those specified in Table 3.0.3.

Allowable Leakage Current Density of Subway Structures **Table 3.0.3**

Materials and structures	Allowable leakage current density (mA/dm^2)
Pig iron	0.75
Steel bars in concrete structures	0.60
Steel structures	0.15

Note: ①The values listed in the Table refer to the hourly average during the running peak of subways;

②The calculation method of leakage current density is detailed in Appendix 2.

Article 3.0.4 As for the indirect indicator leakage current of corrosion hazard, the resulting polarization displacement (voltage) value of electric potential on structures shall take the hourly average measured during the running peak of subways.

Article 3.0.5 As for the external surface of tunnel structure, the control indicator of exposing to stray current corrosion refers to the value of structure voltage displacing from its spontaneous potential which is caused by the leakage current. As for the steel bars in R.C. major subway structures, the average value for the above-mentioned positive displacement of polarization voltage shall not exceed 0.5V.

Article 3.0.6 As for metal over-armor cable directly buried in soil, the hazardous voltage of exposing to stray current corrosion shall be less than or equal to the values listed in Table 3.0.6.

Hazardous Voltage of Cable Metal Over-armor **Table 3.0.6**

Value of "hazardous voltage" (V)		Soil resistivity ρ (Ω.m)
Iron grounding electrode	Measuring reference electrode of copper sulfate	
0	-0.55	<100
0.1	-0.45	100~500
0.2	-0.35	500~1000
0.4	-0.15	>1000

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Note: The values listed in the Table refer to the hourly average during the running peak of subways.

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Chapter IV Limitation on Subway Stray Current Value

Section I Subway Traction Power Supply System

Article 4.1.1 In the DC traction power supply system applying running rail return-flow, the contact line shall be connected with the positive busbar of traction transformer while the return running rail shall be connected with the negative busbar.

Article 4.1.2 High traction voltage and distributed traction power supply schemes should be selected for the traction power supply system of newly-built subway lines; and the distance of DC traction feed shall be shortened.

Article 4.1.3 Under normal operation, the subway contact line shall be powered bilaterally. The non-load voltage value of traction transformer DC bus on both sides of feed section shall be kept in conformation; and it shall not be powered from other sections.

Article 4.1.4 Traction power supply shall not be available from one traction transformer to different subway lines.

Article 4.1.5 At least two cables shall be used as the return-flow wires of traction transformer; its voltage withstand grade shall be greater than or equal to 5kv power frequency.

Article 4.1.6 As for the subway structural steel bars, tap water pipes, cable metal over-armor and other metallic pipeline structures, there shall be no direct electrical connection between them and return running rails as well as power supply cathode.

It may set up polar drainage protection system based on demonstration.

Article 4.1.7 The cathode return-flow wires of traction transformer shall be connected with the running rails of main lines and shall ensure to realize traction current return-flow along both directions at any line section of running rails. It may only allow unidirectional return-flow for single-line section with length on the station line less than or equal to 12.5m as well as the connecting line at depot and overhaul house.

Article 4.1.8 The traction power supply network in subway depot shall have main power supply from the traction transformer of this section as well as standby traction power supply from main line. At the junction of two power supplies, the contact line and return current rail shall realize electric disconnection and shall be installed with corresponding circuit breaker and disconnecting switch respectively; both of them shall be able to achieve synchronous operation.

Article 4.1.9 The connection and transition sections between different subway lines shall be provided with main power supply from the contact line of one subway line and standby power supply from the other subway line. The contact line and running rail of standby power supply lines shall be carried out with electric disconnection from sides of standby power supply as well as the contact line and running rail of transition section; and they shall erected with special circuit breaker and disconnecting switch and shall realize operation interlocking.

The contact rail at unimportant transition section may realize traction power supply from one subway line.

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